Appendix 6: Other Stressor Analyses

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Appendix 6: Other Stressor Analyses

The analyses in this appendix are ones that for various reasons were not deemed eligible for ranking, but which might be of interest to audiences.

For example, the analysis of the socioeconomic impacts of Brownfields was written originally because a member of the Steering Committee insisted that these contaminated sites imposed large burdens on cities, while providing another reason for development to expand into hitherto untouched areas of the state. But since this topic did not match the definition of "stressor" used in the project, the relevant impacts were ultimately incorporated into the Land Use Change analysis. Since Brownfields are of great interest to many people, however, the analysis is reproduced here.

Another example is the analysis of Malaria and Encephalitis, again by the Socioeconomic Technical Work Group. This was originally intended to be folded into a larger analysis, either of Mosquito-borne Illnesses or of impacts due to Climate Change (now Greenhouse Gases). But this analysis was done before the Human Health Technical Work Group decided that health impacts of climate change were far too uncertain to warrant analysis. Without a parallel health analysis, the socioeconomic analysis was removed from the ranking process.

Medical X-ray radiation was eventually removed as a Human Health stressor because it was insufficiently "environmental," although the New Jersey Department of Environmental Protection does have regulatory responsibility for inspecting medical X-ray machines.

Issue: Airborne Pathogens
Author: John Posey
Version: 03/28/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	Findings/Notes
Hazard Identification	
Stressor	**Airborne Pathogens**
Description of stressor	This category includes diseases caused by inhaled viruses, bacteria and fungi. There are both indoor and outdoor airborne pathogens.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Diseases caused by airborne pathogens can include mumps, measles, rubella, tuberculosis, flu, colds, chickenpox, and pneumonia. However, not all cases of these diseases are spread through inhalation. In addition, airborne pathogens can weaken resistance to opportunistic infections.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Cost of illness.
Key impacts selected (critical socio-economic effects)	Costs incurred.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Inhalation
Quantification of exposure levels statewide	According to NJ DHSS, in 1998 there were 8 reported cases of measles, 6 reported cases of mumps, and 14 reported cases of rubella. NIH reports that nationally in 1998 there were 94,800 deaths from influenza and pneumonia. If NJ had a proportional share of cases, then there were nearly 3000 deaths in NJ due to these diseases. However, not all cases of these diseases are spread through the air. TB is spread exclusively through inhalation. According to DHSS, in 1998 there were 920 cases of TB in NJ, and 37 deaths.
Specific socio-economic entities at increased risk	Non-white males aged 25-54 appear to have higher TB rates. Comparative rates for other diseases are not known. Geographically, Hudson and Essex Counties had higher TB rates.
Quantification of exposure levels to entities at increased risk	Hudson and Essex counties have TB rates that are more than twice as high as the rest of the state. For the total population, the NJ TB rate is 7.9 cases per 100,000 population. For "other race" (i.e., not white and not black), aged 25-34, the rate was 68.7. For black males aged 45-54, the rate was 61.8.

Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	I rely on cost-of-illness estimates from NIH, and reported diseases from NJDHSS.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		Score
Property Values	Severity: no impacts hypothesized	*.1*
	Duration/irreversibility	1
	Scale	1
	Uncertainty	1
Employment	Severity: No impacts hypothesized	*.1*
	Duration/irreversibility	1
	Scale	1
	Uncertainty	1
Costs Incurred	Severity: NIH cost-of-illness estimates indicate that in 1991, TB cost the national economy about $700 million in direct costs. This amounts to just over $900 million in 2001 dollars. If costs in NJ are proportional to its population, then we may expect TB to cost the NJ economy about $27 million per year. NIH reports that pneumonia and influenza cost the national economy about $18.6 billion per year, which works out to about $660 million for the state of NJ. However, HHTWG cautions that not all cases of these diseases are spread through the air. Pneumonia is caused by both viruses and bacteria. Pneumonia bacteria are normal inhabitants of the throat and nose, and cause secondary infections when the body is weakened because of a cold or flu. In addition, pneumonia virus and influenza spread through contaminated objects as well as through the air. HHTWG indicates that there is no information concerning the relative number of cases spread through contaminated objects vs. inhalation. Nosocomial (hospital related) infections are potentially a significant subset of indoor pathogenic illnesses. The CDC reports that nosocomial infections cost the U.S. economy about $4.5 billion annually. (If NJ bears a proportional share of the cost, then this would work out to about a $135 million cost to the state economy.) These costs are a subset of the $18.6 million estimated overall cost. However, it should be noted that not all nosocomial infections are airborne.	*2*

	The costs of indoor microbial air pollution should also be considered. (Originally, indoor microbial air pollution was covered in a separate writeup, but I follow the decision of HHTWG to merge the issues.) Indoor microbial air pollution includes several types of microbes, including bacteria, fungi and algae. Fungi appear to pose the most serious risk. Fungal products which result in disease are known as mycotoxins. Harmful fungi include penicillium and stachybotrys. The most significant types of illness caused by indoor microbial air pollution are asthma symptoms and a collection of symptoms known as Sick Building Syndrome (SBS). According to the National Institutes of Health, medical costs and lost productivity associated with asthma cost the national economy about $15 billion each year. If NJ bears a share of this cost that is proportional to its population, then asthma costs the NJ economy about $450 million each year. The National Institute of Medicine (2000) finds that there is "sufficient evidence of an association" between fungi and the exacerbation of asthma. The NIM report indicates that fungi are not among the 5 most important causes of asthma, but that fungal sources are among the top 10. If we estimate that indoor microbial air pollution accounts for 5%-10% of the cost of asthma, then the cost of fungus-related asthma in NJ may be estimated at $22.5 to $45 million. However, it is possible that these costs should be accounted for in the writeup on indoor inducers of asthma. Fisk and Rosenfeld (1997) estimate that SBS costs the US economy about $115 billion each year. This includes direct medical costs, sick leave and restricted activity at work, and lost productivity. If NJ bears a portion of costs that is proportional to its population, then SBS costs the NJ economy about $3.45 billion each year. It must be noted, though, that not all SBS is caused by indoor microbial air pollution. Some non-microbial materials (such as copy toner and various volatile organic compounds) also contribute. In addition, the vast majority of exposure to SBS comes from the work place, which is not to be included in this writeup under NJCRP guidelines. If the cost of SBS were included, then there would have to be a High impact rating in this category.	
	NJCRP guidelines call for a score of "2" to be given to cost impacts between $16 million and $160 million, with a score of "3" to be given to costs greater than $160 million. Costs associated with TB are sufficient to justify a score of 2. If a significant proportion of pneumonia and influenza cases could be shown to be caused by inhalation, then this would justify a score of "3." However, there is insufficient evidence to justify the assertion that a significant number of influenza and pneumonia cases in NJ are spread through the air. A score of "2" should be regarded as a best estimate, with the caveat that the actual costs could be much higher. Duration/irreversibility: Although it will be difficult to eliminate costs associated with airborne pathogens, immunization and education appear to be fairly effective means of reversing the prevalence of many airborne pathogens.	2
	Scale: Although cases of TB appear to be fairly concentrated in a few counties, nosocomial infections, SBS and asthma triggers are statewide problems.	3
	Uncertainty: I am very certain that costs of airborne pathogens exceed $16 million. It is highly possible that costs could be much greater. Still, I believe that a medium severity rating is a reasonable estimate of risk.	2
Aesthetic Levels	Severity: no impacts hypothesized	*1*
	Duration/irreversibility:	1
	Scale	1
	Uncertainty	.1
Psychological Impacts	Severity: no impacts hypothesized	*.1*
	Duration/irreversibility:	1
	Scale:	1

	Uncertainty	1
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M Basic research is needed to determine the number of cases of pneumonia and influenza that are spread through the air, as opposed to other pathways. Ideally, it would be useful to have information about the exposure levels faced by individuals in different types of buildings, i.e., houses, schools, restaurants, etc. Individuals spend each day in multiple locations which might have different levels of indoor microbial air pollution. Therefore, this analysis would benefit from the ability to disaggregate the risk, as opposed to the population-based analysis used here.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ TB cases have been declining in NJ for several years. Immunization programs have controlled such diseases as measles, mumps and rubella.	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	Non-whites have much higher rates of TB.	
Extent to which threat is currently regulated	According to HHTWG, "NJDEP has no regulations controlling levels of indoor air pathogens (J. Held, personal communication). The federal sludge '503' regulations which concern the use and disposal of wastewater treatment biosolids do not address airborne pathogens such as those that may occur at wastewater treatment or sludge composting facilities (USEPA, 1993). Personal respiratory protective equipment guidance and indoor air quality information is offered by the National Institute for Occupational Safety and Health, the Association of Occupational and Environmental Clinics and the American Industrial Hygiene Association, the USEPA Indoor Environments Division, local or county health departments and the NJ Department of Health and Senior Services."	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	L	
Small business industry	L	
Transportation	L	
Residential	M	
Agriculture	M	

Issue: Airborne Pathogens
Author: John Posey
Version: 03/28/00

Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	H
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L
References	NJ Department of Health and Senior Services, Center for Health Statistics (1998). New Jersey Health Statistics 1998. www.state.nj.us/health/chs/stats98 U.S. Department of Health and Human Services, National Institutes of Health (2000). Disease-Specific Estimates of Direct and Indirect Costs of Illness and NIH Support. http://www1.od.nih.gov/osp/ospp/ecostudies/COIreportweb.htm
Current Policy and Regulatory Framework	See "regulation," above.
Federal	
State & Local	

Issue description: Airborne Pathogens. The term "airborne pathogen" applies to any infectious disease which is spread through the air. Three types of airborne pathogens are viruses, bacteria and fungi. Airborne pathogens can cause diseases such as mumps, measles, rubella, pneumonia, influenza and tuberculosis. However, each of these diseases except for tuberculosis can also be spread through pathways other than inhalation. There is insufficient evidence to determine the number of cases of pneumonia and influenza spread by airborne pathogens, as opposed to contaminated objects.

In 1998 there were 920 reported cases of tuberculosis, of which 37 resulted in death. The cost of illness is estimated at approximately $27 million, enough to consider airborne pathogens "moderate" in severity. Costs could be much higher, as nosocomial (hospital-related) diseases cost the U.S. economy more than $4 billion annually, and pneumonia costs the nation nearly $20 billion. If NJ bears a proportional share of these illnesses, then the costs could run into the hundreds of millions. However, it is impossible to estimate the proportion of these diseases that is spread through the air. Thus, these costs are not included in this writeup. Still, the "moderate" impact rating is fairly conservative, and the high uncertainty rating reflects the possibility that costs might be much higher.

Socio-economic Impact Evaluation of Environmental Issue:

Issue: Airborne Pathogens
Author: John Posey
Version: 03/28/00
Scoring system: High (3), Medium (2) and Low (1). Subtotal Risk = multiplicative product of the three factors; Average Risk is the average of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	.1	.1	2	.1	.1
Duration/ Irreversibility	1	1	2	1	1
Scale (spatial, population)	1	1	3	1	1
Subtotal Risk	.1	.1	12	.1	.1

Average Risk (0 – 5 years)
2.48

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	2	1	1	1.4

Long-term socioeconomic impact estimate: Average Risk (5 years plus)
2.48

Trend: + Catastrophic Potential: L

Issue: Antibiotics in Wastewater
Author: John Posey
Version: 02/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Antibiotics in Wastewater

This topic is divided into two parts: human waste and animal waste.

Human Waste:

Kummerer (2000) provides a brief summary of the problem of antibiotics in human excrement:

> After administration, pharmaceuticals are excreted by the patients into the aquatic environment via wastewater. Unused medications are sometimes disposed of in drains. The drugs may enter the aquatic environment and eventually reach drinking water, if they are not biodegraded or eliminated during sewage treatment. Additionally, antibiotics and disinfectants are assumed to disturb the wastewater treatment process and the microbial ecology in surface waters. Furthermore, resistant bacteria may be selected in the aeration tanks of sewage treatment plants by the antibiotic substances present. Since the 1980s, data on the occurrence of pharmaceuticals in natural surface waters and the effluents of sewage treatment plants have been reported. More recently, pharmaceuticals have been detected in ground and drinking water. However, only little is known about the risk imposed on humans by pharmaceuticals and their metabolites in surface and drinking water.

A 1998 review of more than 100 articles on pharmaceutical residues in the environment concluded that "our knowledge is so sparse on the subject it is not possible to conduct thorough environmental risk assessments for any substance." Raloff (1998) reported that the U.S. Food and Drug Administration (FDA) has concluded that drugs "are probably not having a significant environmental effect," and relaxed reporting standards for pharmaceutical companies.

Animal Waste:

The Congressional Research Service offers this overview of antibiotics in animal waste: "Regulators, some scientists, and food safety advocates have raised concerns that the current practice of adding antibiotics to animal feed may encourage emergent strains of bacteria in humans that are resistant to antibiotic treatment. In 1997, the World Health Organization recommended that antibiotics used to treat humans should not be used to promote animal growth, although such antibiotics could still be used to treat ill animals. In July 1998, a National Academy of Sciences report concluded that there is a link between the use of antibiotics in food animals, bacterial resistance to these drugs, and human disease."

The use of antibiotics in pig farming has been made necessary by the growth of "factory farming," in which animals are raised in close confinement, never seeing the light of day. Since these conditions lead to frequent sickness, pig growers habitually add antibiotics to animal feed in order to ward off illness. In its report on antibiotics in animal feed, the National Academy of Sciences concludes that the spread of antibiotic-resistant diseases from animals to humans has historically been insignificant. However, the Academy maintains that data does not allow scientists to ascertain whether incidence of this type of disease transmission may be increasing.

Evaluation:

Issue: Antibiotics in Wastewater
Author: John Posey
Version: 02/01
There is little evidence that pharmaceuticals in human waste cause a significant threat. Antibiotics in animal feed, however, are potentially more dangerous. There is little indication that the spread of antibiotic-resistant diseases will seriously threaten NJ in the next five years. However, this problem poses a long-term threat to human health, and may have catastrophic potential. Such a threat would not be geographically limited. New strains of diseases could arise in other parts of the country, and then spread to NJ through interstate travel. Thus, all residents of the state could potentially be affected.

References:

B. Halling-Sorensen, S. Nielsen, P.F. Lanzky, F. Ingerslev, H.C. Lutzhoft and S.E. Jorgensen. "Occurrence, Fate and Effects of Pharmaceutical Substances in the Environment: A Review." *Chemosphere* 36(2), January 1998.

Jerry Heykoop and Alejandro Segarra. "Animal Agriculture: Current Issues." *Congressional Research Service Issue Briefs*, December 14, 2000.

K. Kummerer. "Drugs, Diagnostic Agents and Disinfectants in Wastewater and Water: A Review." *Schriftenreihe des Vereins fur Wasser-, Boden-, und Lufthygiene* 105, 2000.

Brian Lavendel. "Hog Tying Big Pig Farms." *Milwaukee Shepherd Express* 21(23), June 1, 2000.

National Academy of Sciences. "*The Use of Drugs in Food Animals: Benefits and Risks*." National Academy Press, 1999.

Janet Raloff. "Drugged Waters: Does It Matter that Pharmaceuticals are Turning Up in Water Supplies?" *Science News*, March 21, 1998.

Issue: Antibiotics in Wastewater
Author: John Posey
Version: 02/01

Issue description: Antibiotics in Wastewater: There are two potential issues related to this stressor. First, when humans are medicated, they excrete traces of these drugs into wastewater. It has been hypothesized that antibiotics that enter the aquatic environment in this way could threaten drinking water supplies, and could also affect ecological integrity. There is little indication that this is occurring. The second issue regards the use of antibiotics in animal feed. Authorities including the National Academy of Sciences and the World Health Organization have concluded that the use of antibiotics in animal feed increases the risk of the development of new strains of drug-resistant diseases. These organizations have called for a ban on the use of antibiotics in feed. Antibiotics in animal waste appear to be a potential long-term threat to human health. However, there is little indication that this threat will materialize in NJ in the next five years.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	0.1	0.1	1	0.1	0.1
Duration/ Irreversibility	2	2	2	2	2
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.6	0.6	6	0.6	0.6

Average Risk (0 – 5 years)	Average Risk (5 years plus)
1.68	4.08

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	3	3	3	3	3	3

Trend: --

Catastrophic Potential: M

Asbestos
Author: John Posey
Version: 10/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Asbestos

The term "asbestos" refers to a group of six different fibrous minerals that are found in nature. In the 20th century, asbestos was frequently used for insulation, and for other industrial purposes requiring heat-resistant materials.

Asbestos is a known carcinogen. Estimates of the annual number of asbestos-related lung cancer cases range from 2,000 to 10,000 for the United States. Virtually all of these cases result from occupational exposure. Mesothelioma is a serious type of cancer that affects the lining of the lung, rather than the lung tissue itself. Asbestos is the only known substance associated with mesothelioma.

Since the 1970s, awareness of the hazards of asbestos have resulted in decreasing levels of occupational exposure. Asbestos-related cancer can have a germination period of up to 40 years. Most cases of asbestos-related cancer today result from exposure prior to 1980. Thus, research in the 1990s indicated that the level of asbestos-related cancer is expected to peak around the year 2000, with dramatic decreases occurring over the next 60 years. Lifetime risks are greatest for males in the 1925-29 birth cohort, and decline to almost insignificant levels for the 1955-59 cohort. The risk associated with asbestos is much greater for smokers.

If the number of asbestos-related cancer cases in NJ is proportional to its population, then available evidence indicates that there will be 40 to 100 cases of asbestos-related lung cancer in NJ each year over the next five years. The National Institutes of Health estimates that the average case of lung cancer creates $28,813 in direct costs. This amounts to a cost to the NJ economy in the range of $1.2 million to $2.9 million. NJCRP guidelines call for a score of "1" to be given to costs less than $16 million.

Another serious illness associated with asbestos is asbestosis. This disease creates lung damage, and can be fatal. Estimates of the number of cases, and of the cost, are unavailable. However, it is not likely that the toll of asbestosis exceeds that of asbestos-related lung cancer.

The NJCRP Steering Committee has elected to exclude from the project any environmental hazards that happen to be work-related. Since the health risks associated with asbestos are almost entirely work-related, they are properly beyond the purview of SETWG.

There is one additional socio-economic cost associated with asbestos that deserves some consideration. The demolition of derelict structures in urban areas is hindered by EPA regulations regarding asbestos. On city blocks containing more than one structure with asbestos, the regulations require that a certain period of time must elapse between the demolition of one structure and the demolition of the next. Officials of several cities have expressed frustration with these regulations. First, they argue that the regulations are unclear with respect to the amount of time that must elapse. Second, they argue that these regulations inhibit redevelopment. Third, they argue that the EPA overstates the risk associated with the demolition of structures containing asbestos. Finally, they argue that the EPA fails to take into consideration the public health risk associated with the existence of the derelict structures themselves. For these reasons, the City of St. Petersburg has challenged EPA regulations pertaining to demolition in court. It would behoove the redevelopment community and the environmental community to work together in order to find demolition guidelines that maximize the common good.

Asbestos
Author: John Posey
Version: 10/00

References:

B. Price. "Analysis of Current Trends in United States Mesothelioma Incidence." *American Journal of Epidemiology*, 145(3):211-8. 1997.

T. Reynolds. "Asbestos-Linked Cancer Rates Up Less Than Predicted." *Journal of the National Cancer Institute*, 84(8):560-62. 1992.

I.J. Selikoff. "Asbestos Disease—1990-2020: The Risks of Asbestos Risk Assessment." *Toxicology and Industrial Health*, 7(5-6):117-27. 1991.

New Jersey Department of Health and Senior Services. "Asbestos: Hazardous Substance Fact Sheet." 1994.

Agency for Toxic Substances and Disease Registry. "ToxFAQ: Asbestos." 1996.
www.atsdr.cdc.gov/tfacts61.html

National Institutes of Health. "Disease-Specific Estimates of Direct and Indirect Costs of Illness and NIH Support." 1997.

City of St. Louis. *Consolidated Annual Performance and Evaluation Report*. 1996.

Asbestos
Author: John Posey
Version: 10/00
Issue description: Asbestos is a carcinogenic substance used for insulation and for other industrial purposes. Nationally, there are 2,000 to 10,000 cases of lung cancer per year among workers exposed to asbestos. Most of these cases resulted from exposure prior to 1980. Since the 1970s, workplace exposure to asbestos has been greatly reduced, and the number of asbestos-related illnesses is expected to decrease over the next few decades. If the number of asbestos-related cancer cases in NJ is proportional to its population, then available evidence indicates that there will be 40 to 100 cases of lung cancer in NJ each year over the next five years. The National Institutes of Health estimates that the average case of lung cancer creates $28,813 in direct costs. This amounts to a cost to the NJ economy in the range of $1.2 million to $2.9 million. NJCRP guidelines call for a score of "1" to be given to costs less than $16 million. The NJCRP Steering Committee has elected to exclude from the project any environmental hazards that happen to be work-related. Since the health risks associated with asbestos are almost entirely work-related, they are properly beyond the purview of SETWG.

EPA regulations pertaining to the demolition of structures containing asbestos have been criticized by officials of some U.S. cities on the grounds that they inhibit redevelopment.
Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	.1	1	.1	1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	2	1	2	1	1
Subtotal Risk	2	.1	2	.1	1

Average Risk (0 – 5 years)	Average Risk (5 years plus)
1.04	.804

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	1	1

Trend: ++
Catastrophic Potential: L

Issue: Brownfields
Author: John Posey
Version: 06/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Brownfields**
Description of stressor	A brownfield is a plot of land on which contaminated soil or the perception of contamination reduces property value or hinders economic activity. Brownfields are typically former industrial sites in urban areas.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Employment, Property Values, Costs, Aesthetic Impact, Worry.
Key impacts selected (critical socio-economic effects)	Employment, Property Values, Costs
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Common sources of soil contamination include Leaking Underground Storage Tanks (LUSTs), chemical and metal contamination from abandoned industrial sites, and contamination from heating oils used prior to 1945.
Quantification of exposure levels statewide	A 1997 NJDEP survey indicated that there are 10,782 known contaminated sites in New Jersey.
Specific socio-economic entities at increased risk	Urban counties.
Quantification of exposure levels to entities at increased risk	The following table indicates the number of known contaminated sites in each county, as of September 1997. This is an imperfect measure, as it does not communicate the total land area that is contaminated. It may be useful, however, for a rough ranking of counties affected by brownfields: ATL 464 MID 899 BER 1012 MON 911 BUR 487 MOR 941 CAM 493 OCE 430

Other Stressor Analyses

	CAP 165 PAS 614 CUM 156 SAL 79 ESS 903 SOM 426 GLO 252 SUS 324 HUD 768 UNI 641 HUN 252 WAR 136 MER 428 Additionally, information on brownfields in certain municipalities is available: SITES ACRES BAYONNE 16 300 BRIDGEWATER 45 45 CLIFTON 20 50 EDISON 5 20 ELIZABETH 56 825 HOPE 1 10 IRVINGTON 32 JERSEY CITY 94 2000 NEWARK 25 250 PASSAIC 6 50 PERTH AMBOY 25 300 TRENTON 75 UNION CITY 3 2
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	Studies relied upon include a survey of known contaminated sites conducted by NJDEP, a survey conducted by the U.S. Conference of Mayors which asked city officials to estimate the economic impact of brownfields, hedonic regression analyses that estimated property value losses caused by brownfields, and a brownfields redevelopment analysis by the National Center on Neighborhoods and Brownfield Redevelopment.
Risk Characterization	
Risk estimate(s) by socio-economic entities at risk	*Score*

Property Values	***a)*** Severity: Greenberg et al. (2000) estimate that 10% of all towns in New Jersey have at least one brownfield that reduces property values up to ¼ mile away. Simons, Bowen and Sementelli (1999) estimate that residential properties within 300 feet of a LUST suffer a 17% reduction in value, while commercial properties within 300 feet of a LUST lose 33% of their market value. Greenberg and Hughes (1993) report that 28% of assessors in towns with hazardous waste sites report that market values are reduced by at least 5% in the area within ¼ mile of the site. McClelland, Schulze and Hurd use a hedonic regression model to demonstrate that houses in an area around a landfill saw their values reduced by $10,000, or about 8%. Thus, there are various estimates of property value impacts for various types of brownfields. Estimates of property values lost because of proximity to brownfields included "greater than 5%", 8%, 17% and 33%. Unfortunately, there are no available estimates of the total land area of NJ brownfields. Another key missing piece of information is the number of residential and commercial units which are within ¼ mile of a brownfield. Thus, another missing piece of information is the current assessed value of land sitting within ¼ mile of a brownfield. Without these numbers, it is not possible to provide a precise measurement of reductions in property value due to brownfields. Still, it is known that there are over 10,000 brownfields in NJ, which averages to more than 1 per square mile. Additionally, is it well documented that properties within ¼ mile of a brownfield will suffer a loss of value upwards of 8%. Since brownfields are so heavily concentrated in urban areas, it seems clear that brownfields are a major reason for depressed property values in urban areas. Given all of these factors, it seems reasonable to conclude that brownfields reduce property values statewide by more than 1%.	2
	b) Duration/irreversibility: Brownfield cleanup is costly, but possible.	2
	c) Scale: The problem is concentrated in urban counties.	2
	d) Uncertainty: I would have little confidence in any particular dollar amount, but I am reasonably confident that brownfields constitute a moderate threat to property values statewide.	2

Employment	***a)*** Severity: Two studies have tried to estimate the number of jobs lost because of brownfield contamination. First, a survey by the US Conference of Mayors asked city officials to estimate the number of permanent jobs that could be supported on brownfields if these sites were redeveloped. Eight New Jersey cities responded to this question on the survey. The total number of jobs lost because of brownfields in these eight cities was estimated to be 29,800. This estimate may be challenged on the grounds that commercial/industrial tenants might not materialize even if the sites were redeveloped. However, the strength of the New Jersey commercial/industrial market indicates that the market could absorb additional space. A 1998 symposium by the Society of Industrial and Office Realtors analyzed the commercial real estate markets in northern, central and southern New Jersey. Vacancy rates on industrial properties were at or below 5% in both northern and southern New Jersey. Industrial rates in central New Jersey were not available, though the absorption rate was called "steady," and rents were increasing. In the office market, vacancy rates in northern New Jersey were called the lowest in 15 years. The central New Jersey class A office market enjoyed a 7% vacancy rate, southern NJ vacancies were dropping. A January 2000 panel discussion conducted by Business News New Jersey indicated strong pent-up demand for industrial space in NJ. An industrial realtor in central NJ enjoyed a 97-98% occupancy rate, and a realtor in northern NJ reported being 100% leased for more than two years. The strength of the industrial real estate market, as illuminated by these two symposia, indicates that the employment estimates produced by the US Conference of Mayors is not obviously unrealistic. A second study, conducted by the National Center on Neighborhoods and Brownfield Redevelopment (NCNBR) at Rutgers University, lends some support to the Mayors' study. NCNBR studied a sample of NJ brownfields. The team consulted with experts to determine redevelopment options most likely to succeed on these sites. NCNBR then extrapolated the results of this study to produce statewide employment estimates. They concluded that brownfield sites, if redeveloped, would create 19,000 – 66,000 permanent jobs, in addition to at least 25,000 construction jobs. Thus, it seems fairly reasonable to place the "best guess" employment impact estimate at around 30,000 jobs. The speculative nature of these estimates must be stressed. Remediated brownfields do not automatically become redeveloped with high employment industrial sites. Moreover, it may be that the existence of brownfields has redistributed new industrial sites within the state. Because of brownfields, most new industrial development has occurred on greenfields in recent years. The remediation of brownfields may create new industrial sites, but this new construction will likely be at the expense of new construction on greenfields. Thus, complete remediation would not ensure a net increase in employment for the state. Even if this view is correct, however, brownfields may still be seen as significant contributors to unemployment in the state. Since brownfields have pushed new industrial developments out to exurban areas, brownfields may be seen as contributing to a "spatial mismatch" in which manufacturing jobs are unavailable to persons in high unemployment areas. The NJCRP guidelines for assessing the severity of employment impacts requires that a score of "2" be given to all impacts falling between 20,000 and 200,000.	2
	b) Duration/irreversibility: Brownfield cleanup is expensive, but possible.	2

	c) Scale: Urban centers are the hardest hit.	2
	d) Confidence: The similarity of the estimates produced by the US Conference of Mayors and the NCNBR, in addition to independent evidence about the strength of the NJ industrial real estate market, leads me to conclude that the "best guess" estimate is not unreasonable.	2
Costs Incurred	***a)*** Severity: The principle costs considered here are lost tax revenues. According to Greenberg, measurable health effects of brownfields are not notable, although additional research on this topic is needed. Two studies have produced estimates of lost tax revenue for the state of NJ. First, the US Conference survey asked city officials to estimate the minimum and maximum amount of tax revenues lost because of idle brownfields. The minimum guess was placed at $16 million for the 8 cities in NJ that responded, while the maximum guess was placed at $30 million. Since only 8 cities responded, these figures must be considered as an underestimate of the statewide problem. Second, the NCNBR survey also attempted to estimate statewide impacts. They concluded that there are at least $62 million in lost tax revenues statewide due to brownfields. NJCRP guidelines assign a value of "2" to damage costs ranging between $16 million and $160 million.	2
	b) Duration/irreversibility: Brownfield cleanup is expensive, but possible.	2
	c) Scale: Urban centers are hardest hit.	2
	d) Confidence: Based on the convergence of two surveys, I believe that it is reasonable to conclude that the total cost is between $16 million and $160 million. Assessors are capable of estimating lost tax revenues, and may be trusted to report these effects honestly.	2
Aesthetic Levels	***a)*** Severity: Brownfields are commonly thought of as visually unappealing sites. A search of the Dow Jones periodical index found 116 articles on brownfields which contain the word "eyesore." Brownfields frequently contain TOADS (temporarily obsolete abandoned derelict sites), or vacant buildings. The sight of a boarded up building or a field protected by barbed wire can seriously reduce the visual appeal of surrounding areas.	2
	b) Duration/irreversibility: Brownfield cleanup is expensive, but possible.	2
	c) Scale: Urban centers are hardest hit.	2
	d) Confidence: I am moderately confident that this assessment is reasonable.	2
Psychological Impacts	***a)*** Severity: Greenberg (1996) reports on interviews that he conducted with more than 1800 persons in neighborhoods with brownfields. His account indicates that persons who live near brownfields experience a high degree of anxiety. When a community is worried about contaminated sites, anyone who can afford to do so will leave. Greenberg states, "such feelings dominate many residents' perceptions when a new hazardous use is added in their environment. The undesirable land uses outweigh such traditional measures of a good neighborhood as good schools, parks, and public transportation."	2
	b) Duration/irreversibility: Brownfield cleanup is expensive, but possible.	2
	c) Scale: Urban centers are hardest hit.	2
	d) Confidence: I am moderately confident that this assessment is reasonable.	2
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	M: It would be helpful to know the following: 1) The amount of acreage in NJ that may be considered "brownfield." 2) Number of residential and commercial properties located within ¼ mile of a brownfield. 3) More precise accounting of property value losses due to nearby contamination. 4) Much more needs to be known about the health effects of brownfields.	
Potential for future changes in the underlying	+ New Jersey is a leader in the field of brownfield remediation, but the rate of remediation is quite slow.	

changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	
Potential for catastrophic impacts (H,M,L) and brief description	L
Incidence of impacts (affected sub-groups, variability, equity issues)	Brownfields are overwhelmingly concentrated in poor and urban communities. Greenberg's (2000) characterization of TOAD placement applies well to the problem of brownfields generally: [M]unicipalities with the most severe TOADS have the poorest populations, the least expensive housing, and the lowest proportion of white residents. They are also the jurisdictions with the most residents….[Those] without brownfields have the most affluent residents, the most expensive housing, and the highest proportion of white residents. These municipal populations average less than 10,000 people." Brownfields must be considered one of the most important environmental justice issues facing the state.
Extent to which threat is currently regulated	See below under federal and state regulatory framework.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	H
Small business industry	H
Transportation	M: Railway lines are frequently classed as brownfields.
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	M: Former military bases (e.g., Bayonne) often require cleanup.
Natural sources/processes	L
Orphan contaminated sites	H

Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. Deposition	L
Biota sinks	L
References	State of New Jersey, Department of Environmental Protection. "Known Contaminated Sites." 1997. www.state.nj.us/dep U.S. Conference of Mayors. "Recycling America's Land: A National Report on Brownfields Redevelopment." 1999 and 2000 editions. Michael Greenberg et al. "Brownfields, TOADS, and the Struggle for Neighborhood Redevelopment." *Urban Affairs Review*, May 2000. Robert A. Simons et al. "The Price and Liquidity Effects of UST Leaks from Gas Stations on Adjacent Properties." *Appraisal Journal*, 4/1/99. James Prior. "SIOR Forcast: It's Great in '98!" NJ Business, 4/1/98. "Industrial Players Deal With Pent-Up Demand." Business News NJ, 1/18/2000. Tyler Miller et al. "Brownfields Redevelopment as a Tool for Smart Growth: An Analysis of Nine NJ Municipalities." A report by the National Center for Neighborhood and Brownfields Redevelopment for the NJ Office of State Planning. 3/16/2000. Michael Greenberg et al. "There Goes the Neighborhood." *Planning*, 2/1/96. NJ DEP Home Page: www.state.nj.us/dep US EPA Home Page: www.epa.gov
Current Policy and Regulatory Framework	
Federal	*The following information on the federal initiatives was taken from the US EPA home page:* The Brownfields National Partnership Action Agenda includes more than 100 commitments from more than 25 organizations including more than 15 Federal agencies. These commitments represent a $300 million investment in brownfields communities by the Federal government and an additional $165 million in loan guarantees. The resulting action will help cleanup and redevelopment at up to 5,000 properties, leveraging from $5 billion up to $28 billion in private investment, supporting 196,000 jobs, protecting up to 34,000 acres of "greenfields" and improving the quality of life for as many as 18 million Americans living near brownfields.

	On August 5, 1997, President Clinton signed the Taxpayer Relief Act (HR 2014/PL 105-34), which included a new tax incentive to spur the cleanup and redevelopment of brownfields in distressed urban and rural areas. The Brownfields Tax Incentive builds on the momentum of the Clinton Administration's Brownfields National Partnership Action Agenda, announced in May 1997. The National Partnership outlines a comprehensive approach to the assessment, cleanup, and sustainable reuse of brownfields, including specific commitments from 15 Federal agencies. The Brownfields Tax Incentive will help bring thousands of abandoned and under-used industrial sites back into productive use, providing the foundation for neighborhood revitalization, job creation, and the restoration of hope in our nation's cities and distressed rural areas. The Superfund program has been the most important federal law pertaining to brownfields over the last 20 years. Key dates in the program are shown below. The following initiatives are included: Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Hazard Ranking System (HRS), National Priorities List (NPL), and Construction Completion List (CCL). CERCLA--Comprehensive Environmental Response, Compensation, and Liability Act: enacted December 11, 1980 — trust fund of $1.6 billion is authorized over 5 years. SARA: CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) enacted October 17, 1986 — trust fund of $8.5 billion is authorized over 5 years; extended to September 30, 1994 — additional $5.1 billion is authorized. NCP: National Oil and Hazardous Substances Pollution Contingency Plan implements Superfund. Revised July 16, 1982 (47 FR 31180) to incorporate CERCLA requirements; amended by SARA October 17, 1986; revised March 8, 1990 (55 FR 8666) in response to CERCLA Section 105. HRS: Hazard Ranking System. Promulgated July 16, 1982 (47 FR 31180) as Appendix A of the NCP; revised December 14, 1990 (55 FR 51532) in response to CERCLA Section 105(c) added by SARA; effective date March 14, 1991. NPL: National Priorities List . Promulgated September 8, 1983 (48 FR 40658) as Appendix B of the NCP; last sites proposed under original HRS promulgated February 11, 1991 (56 FR 5598); first sites proposed under the revised HRS July 29, 1991 (56 FR 35840); first sites added to the NPL under the revised HRS October 14, 1992 (57 FR 47181). CCL: Construction Completion List. Category activated February 11, 1991 (56 FR 5634); list activated March 2, 1993 (58 FR 12142).
State & Local	A key change in state environmental policy occurred in 1993 when Governor Jim Florio signed the Industrial Site Recovery Act. The law replaced the old Environmental Clean-Up Responsibility Act (ECRA). *HAZNEWS* described the change as follows: Under **ECRA** , the seller had the sole responsibility to clean-up the site, regardless of whether the site would be used for the same purpose by the new owner. It was also not possible for the buyer to undertake the clean-up and the seller to reduce the purchase price accordingly. Prior to starting any clean-up, each site had to undergo a review process. During this review process, the regulatory authorities would survey the site and determine what clean-up method was to be used. This could take several years before the clean-up could start and the property could be sold. Under **ISRA** , sites will still require clean-up to State standards but: the buyer and seller can negotiate on who is to perform and pay for the clean-up work; the clean-up of most sites can start prior to final approval by the state authorities; and the purchasing business will be able to defer any

	clean-up if the use of the property remains substantially unchanged. Up to $50 million is available in grants, low-interest loans and loan guarantees to businesses that cannot find alternative financing for clean-ups. Providing financial assurance will relieve smaller companies of the need to post a separate clean-up bond while drawing on other funds to pay for a clean-up in New Jersey. *The following information on the state brownfield remediation program was taken from the NJDEP home page:* The Brownfield and Contaminated Site Remediation Act signed into law on January 6, 1998 provides for the latest changes in New Jersey's environmental cleanup guidance. The act, formally part of Senate Bill Number 39 (Public Law 1997, c.278), adds new provisions that advance brownfields reuse as part of a comprehensive program for urban redevelopment. The overall law amends the Hazardous Discharge Site Remediation Act, Spill Compensation and Control Act, Industrial Site Recovery Act, Environmental Opportunity Zone Act and other key statutes. The most important liability provisions of the 1998 law are that it protects buyers of tainted sites from private lawsuits and from having to perform additional cleanup work, both related to past contamination problems, if they clean up the site in accordance with NJDEP regulations. Such buyers also must not be a party responsible for the site's original pollution problems. The brownfield act also established a Brownfields Redevelopment Task Force to coordinate state policy on brownfields redevelopment, including incentives, regulatory programs, provision of infrastructure, and redevelopment planning assistance to local governments. The task force will include five members from state agencies, including NJDEP's Site Remediation Program, and six members of the public, and will receive staff support from the Office of State Planning.

Issue: Brownfields
Author: John Posey
Version: 06/00

Brownfields are urban plots of land characterized by underuse and real or feared contamination. Brownfields reduce property values, reduce the quality of life in affected communities, destroy job-creating redevelopment opportunities, and deprive cities of needed tax revenue. Credible estimates indicate that brownfields reduce statewide property values by more than 1%, cost the state approximately 30,000 jobs, and deprive cities of approximately $60 million in tax revenue each year.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	2	2	2	2	2
Duration/ Irreversibility	2	2	2	2	2
Scale (spatial, population)	2	2	2	2	2
Subtotal Risk	8	8	8	8	8

Average Risk (0 – 5 years)	Average Risk (5 years plus)
8	**8**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	2	2	2	2	2	2

Trend: +
Catastrophic Potential: L

Issue: HH Medical and X-ray Radiation
Author: John Posey
Version: 09/00

NJ Comparative Risk Project
Socio-economic TWG
Stressor-Specific Assessment

HH Medical and X-ray Radiation

Channelization

The term "Channelization" refers to the alteration of streams through the construction of levees, the straightening of stream channels, and the dredging of streambeds. Channelization projects are usually motivated by a desire to improve navigability, or to control flooding. Channelization may also be used as a way to drain wetlands in order to use these lands for development or agriculture.

Channelization can harm the environment in several ways. First, it can destroy the habitats of aquatic plants and animals. Second, it can destroy the wetlands that exist at the edge of streams. These wetlands normally absorb overflow water, and therefore are areas of rich biodiversity. Third, channelization can result in increased flooding downstream. Fourth, channelization can increase the speed of water flow, leading to increased erosion on parts of the stream bank, altering sediment deposition, and thereby changing the underwater topography. Finally, channelization diminishes the aesthetic appeal of rivers and streams.

The benefits of channelization can be temporary. The use of channelization over several decades in the Midwest contributed to the severity of the 1993 floods. Structural flood control in the upper Mississippi led to higher water levels in the portion of the Mississippi that lies between Missouri and Illinois. Moreover, the use of levees and straightening increased the speed of water flow, which increased the severity of water damage. Finally, changing the speed of water flow led to erosion and changed sediment deposition downstream. These considerations led James Tripp of the Environmental Defense Fund to conclude that the floods of 1993 were "a man-made disaster."

Over time, waterways tend to revert to their natural courses. A *Star-Ledger* article on the subject quoted a senior DEP official as follows: "The truth is, dredging is a total waste of money. You can dig down to China. Every stream has a natural grading, and if you dig the material out, it will revert and fill itself back up again." Dredging, by itself, cannot be considered a long-term method of flood control.

There are two major ongoing channelization projects in NJ: The Ramapo River project in Oakland, and the Green Brook Flood Control Project in Middlesex, Union and Somerset counties. Smaller recent or ongoing projects include the Molly Ann's Brook project in Paterson, the Pond Run project in Hamilton Township, and the West Brook and Jouet Brook projects in Union County. The Ramapo project will destroy five acres of wetlands. It will also, according to one DEP official, "destroy one of the best trout rivers in the state." The cost of the project is estimated to be $12.4 million, of which the federal government will pay 75%. NJ taxpayers will fund the remaining 25%.

The Green Brook project is a massive effort by the U.S. Army Corps of Engineers, with an estimated cost of $360 million. The federal government is providing 75% of the funds, and NJ taxpayers will pay the remaining 25%. The project originated as a response to a rare flood that killed six people in 1973. It will take approximately 12 years to complete. The plan calls for 12.6 miles of levees, 2.1 miles of floodwalls, and 3.4 miles of channel modifications. The plan would also result in the loss of 108 acres of wetlands, including 97 acres of palustrine forest. The project has drawn the objections of environmental activists. Jeff Tittel of the NJ Sierra Club has argued that "this project will fail because it pushes water somewhere else instead of allowing it to percolate back in the ground and restore natural aquifers." Tittel argues that the state flood control policy should involve the curtailment of development, which would reduce paved surfaces and allow more natural absorption of water.

There is insufficient evidence with which to predict the ultimate costs of this project. For this reason, SETWG has elected to produce this short report, rather than a full writeup. However, there are three types of socio-economic impacts that deserve to be taken seriously. First, it may be anticipated that channelization projects will result in property damage, although it is not possible to accurately predict exactly where this property damage will occur. Large volumes of water will not be able to overflow Green Brook, and large volumes of water will not be absorbed because of the destruction of wetlands. This water will have to flow somewhere, and it is likely that property damage will occur. In

addition, the project will encourage further development in flood plains, which will exacerbate the amount of damage created when the flood controls fail. It is not possible to predict when this will be. However, it is reasonable to expect that such a failure may occur sometime in the next century.

Issue description: Channelization is the alteration of streams for the purposes of flood control or improved transportation. It may involve dredging, straightening, and the use of levees. Channelization can kill aquatic organisms, destroy wetlands, cause erosion, and create additional flooding downstream. Two ongoing channelization projects in NJ are the Ramapo River project in Oakland, and the Green Brook Flood Control Project in Middlesex and Somerset Counties. Their combined cost over the next 10 years will amount to an estimated $375 million. Channelization projects are very controversial. Environmentalists point out that channelization, in the long run, increases the damage wrought by floods. There are three types of socio-economic impacts associated with channelization: 1) The costs of construction; 2) losses of property in areas to which floodwater is redirected; and 3) aesthetic impacts. Although these impacts are all serious long-term threats, it is impossible to predict the amount of damage expected over the next five years. For this reason, the impact estimates on this page appear to be minimal. However, the long-term dangers of channelization deserve attention, and additional research.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	1	0.1	2	2	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	0.1	2	2	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
1.04	**1.04**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	3	3	3	3	3	3

Trend: 0
Catastrophic Potential: M

What is it?
Diagnostic X-rays used in dental and medical settings are a type of ionizing radiation. Like other forms of ionizing radiation, X-rays have the ability to penetrate the human body and interact with human cells, potentially causing both acute and chronic effects. Some of these include cancer, cataracts, skin irritation and burns, hair loss, and genetic damage.

Issue: HH Medical and X-ray Radiation
Author: John Posey
Version: 09/00
Health effects resulting from X-rays often do not present until years after exposure. The most common are leukemia and other cancers, cataracts, genetic damage, and shorter life span. It is generally accepted that although diagnostic X-rays may result in a certain number of cancer cases, they prevent a much larger number of cancer fatalities.

What's at risk?
Virtually everyone will have an X-ray procedure at some point in their lives, and in a given year 65% of the U.S. population will receive at least one procedure. Thus, about 5.3 million New Jersey citizens will undergo an X-ray each year. Anyone who has an X-ray is at risk from developing health effects, but the unborn and the elderly are the most radiosensitive groups.

What are the human health impacts in New Jersey?
The actual amount of X-ray radiation a New Jersey citizen receives is unknown since the number and type of procedures and the amount of radiation per procedure are not known. Most radiobiological effects are known to increase with increased exposure, and there is no safe or threshold level of exposure. According to a U.S. Food and Drug Administration study, 50 million single exposure chest X-ray procedures may result in an estimated 23 excess fatal cancers, just under 1 excess fatal cancer for every 2 million chest X-rays.

What's being done?
New Jersey requires licensure of operators of X-ray equipment, and there are regulations governing equipment performance and personnel safety. Periodic inspections of equipment help ensure that proper dosages are being administered. In addition, the medical community is generally more cautious about the use of X-rays than in the past, and as overuse decreases, the incidence of cancers should follow.

Human Health Risks	**[not completed on assessment]**
Trend	Overuse of X-rays is expected to continue to decline, and the benefits of X-ray technology in both medicine and industry must be weighed against the potential risks.

A second category of costs are the direct costs involved in the construction of channelization structures. NJ taxpayers may reasonably ask whether there are better uses for $360 million.

Finally, the aesthetic impacts of the project are not trivial. Channel modifications will inevitably kill organisms that thrive in the banks and sediments of the brook, and the destruction of wetlands will have an impact on biodiversity.

SETWG is not able to quantify the ultimate impact of channelization. This, however, does not mean that the impacts will be minimal. Additional DEP research on the future impacts of channelization is warranted.

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Issue: Malaria
Author: John Posey
Version: 09/00

New Jersey Comparative Risk Project
Socio-economic TGW
Stressor-Specific Risk Assessment

Malaria

The following is taken from the home page of the Centers for Disease Control:

Malaria is a serious, sometimes fatal, disease caused by a parasite. There are four kinds of malaria that can infect humans: Plasmodium falciparum, P. vivax, P. ovale, and P. malariae. Malaria occurs in over 100 countries and territories. The World Health Organization estimates that yearly 300-500 million cases of malaria occur and more than 1 million people die of malaria. About 1,200 cases of malaria are diagnosed in the United States each year. Most cases in the United States are in immigrants and travelers returning from malaria-risk areas, mostly from sub-Saharan Africa and the Indian subcontinent. Humans get malaria from the bite of a malaria-infected mosquito. When a mosquito bites an infected person, it ingests microscopic malaria parasites found in the person's blood. The malaria parasite must grow in the mosquito for a week or more before infection can be passed to another person. If, after a week, the mosquito then bites another person, the parasites go from the mosquito's mouth into the person's blood. The parasites then travel to the person's liver, enter the liver's cells, grow and multiply. Symptoms of malaria include fever and flu-like illness, including shaking chills, headache, muscle aches, and tiredness. Nausea, vomiting and diarrhea may also occur. Malaria may cause anemia and jaundice because of the loss of red blood cells. Malaria can be cured with prescription drugs.

The following information is taken from the home page of the NJ Department of Health and Senior Services:

Over the period 1988-2000, there was an average of 63.7 cases of malaria diagnosed in NJ each year. New Jersey has one species of mosquito, which is capable of carrying malaria, but mosquito control efforts, and prompt treatment of human cases of malaria have eradicated malaria from the mosquito populations in the United States. Until shortly after World War II, malaria did occur regularly in the United States. Today, virtually all cases of malaria which are diagnosed in the United States are a result of travel to parts of the world where mosquitoes are still infected and where malaria transmission still occurs.

Since malaria cases in NJ result almost exclusively from travel to other parts of the world, malaria should not be considered a threat in the NJ environment. In the September 8, 2000 edition of Science, David Rogers and Sarah Randolph argue that malaria could become more prevalent in temperate climates if global warming occurs. However, indigenous malaria is currently a minimal threat in NJ.

Encephalitis is another mosquito-borne disease that occurs in some parts of the U.S. There have been no reported cases of the disease in the last five years. However, there was an eruption of 6 cases in the U.S. in 1993. While the risk of encephalitis in NJ is minimal, continued efforts at mosquito surveillance and control would appear to be warranted.

Malaria and encephalitis are serious, and sometimes fatal, mosquito-borne diseases. However, these diseases have been virtually eradicated in NJ's mosquito population. There is little risk that indigenous malaria or encephalitis will create measurable socio-economic impacts in the next five years.

Issue: Malaria
Author: John Posey
Version: 09/00

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socio-economic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	1	0.1	0.1
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	0.1	0.1	1	0.1	0.1

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
0.28	**0.28**

Socio-economic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psycholog-ical Impacts**	**Average Uncertain-ty**
Uncertainty Level	1	1	1	1	1	1

Trend: 0
Catastrophic Potential: L

Issue: Medical X-Ray Radiation
Author: John Posey
Version: 09/00

New Jersey Comparative Risk Project
Socio-economic TGW
Stressor-Specific Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**SE Medical X-Ray Radiation**
Description of stressor	The primary source of medical radiation is diagnostic x-rays. X-radiation, like other types of radiation, is considered carcinogenic.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	Cancer is the principal risk associated with medical radiation. Socio-economic impacts related to cancer include medical costs and lost productivity. Psychological stress resulting from worry about x-rays is a lesser risk.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	Costs incurred, psychological impacts.
Key impacts selected (critical socio-economic effects)	Costs incurred, psychological impacts.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	Individuals who receive dental x-rays or x-rays ordered by a physician constitute the socio-economic entities at risk.
Quantification of exposure levels statewide	Nationally, approximately 70% of the population receives a medical x-ray in a given year. In the absence of contradictory evidence, I will assume that this figure is representative of NJ. Virtually every American will receive a medical x-ray at least once in his/her life.
Specific socio-economic entities at increased risk	There is no evidence that exposure to x-rays is related to demographics or socio-economic status.
Quantification of exposure levels to entities at increased risk	Same as statewide.
Dose/Impact-Response Assessment	
Quantitative/Qualitative impact-assessment employed	I rely on cost-of-illness information from the National Institues of Health, and from a literature review on the epidemiology of radiation carcinogenesis in JAMA.

Other Stressor Analyses

Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	***a)*** Severity: No hypothesized impacts.	0.1
	b) Duration/irreversibility	2
	c) Scale	3
	d) Uncertainty	1
Employment	***a)*** Severity: No hypothesized impacts.	0.1
	b) Duration/irreversibility	2
	c) Scale	3
	d) Uncertainty	1
Costs Incurred	***e)*** Severity: A 1991 article in JAMA included the following estimate of cancer cases related to x-rays: "Estimates of the total cancer burden attributable to medical radiology have clustered around 1% for leukemia and perhaps 1% to 2% for all other cancers. Recently, however, a National Academy of Sciences' committee reported that estimates of lifetime cancer risk following relatively low doses of radiation may be as much as four times larger than previously thought." If these estimates are correct, then 1-8% of all non-leukemia cancers may be related to x-rays, and 1-4% of leukemias may result from x-rays. Estimates from the National Institutes of Health indicate that the total cost of cancer in the U.S. is about $84 billion per year, including direct medical costs, lost work days and lost productivity. (This does not include the lost lifetime productivity of cancer fatalities.) (See Brown, 2001 and the writeup on 1,3 Butadiene for details of this estimate.) According to the American Cancer Society, cancer incidence rates in NJ are slightly higher than in the nation as a whole. If we assume that NJ bears a proportionate share of the cost, then we would expect cancer costs in NJ to amount to about $2.5 billion annually. As noted, a JAMA literature review blames medical radiation for between 1% and 8% of all cancer cases. Applying this range to the $1.5 billion total cost of cancer yields the following cost estimate range: $2.5 billion * 1% = $25 million $2.5 billion * 8% = $250 million NJCRP guidelines call for a score of "2" to be given to all impacts between $16 million and $160 million. These estimates of cancer costs related to medical radiation seem to fall solidly into this category. It should be noted that even the most cautionary voices (e.g., John W. Gofman) acknowledge that x-rays are, on balance, beneficial to society. Even though x-rays may cause a certain number of cancer cases, they prevent a much larger number of cancer fatalities.	2
	f) Duration/irreversibility: Next to heart disease, cancer is the leading cause of death in America. Yet there are currently no good diagnostic tools that can substitute for medical X-rays. Thus, damage caused by cancer may be considered highly irreversible.	3
	g) Scale: Statewide	3

Other Stressor Analyses

	h) Uncertainty: I am moderately confident that the total costs associated with medical radiation carcinogenesis are between $16 million and $160 million.	2
Aesthetic Levels	***e)*** Severity: None hypothesized	0.1
	f) Duration/irreversibility:	2
	g) Scale	3
	h) Uncertainty	1
Psychological Impacts	***a)*** Severity: Periodically, reports on the dangers associated with x-rays appear in the popular media. One recent report that generated a fair amount of press coverage asserted that x-rays are a necessary co-actor in 50% of all fatal cancer cases. Reports such as these may make individuals worried about the dangers associated with x-rays.	2
	b) Duration/irreversibility: 70% of all Americans receive at least one x-ray each year. Thus, most of the population appears to face a fairly continuous exposure to x-rays. Thus, anxiety over x-ray use may be relatively long-lasting.	2
	c) Scale: Statewide	3
	d) Uncertainty: I am not very confident that this assessment is correct.	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	L: The dangers of medical radiation are widely acknowledged.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	+ The medical community is more cautious about the use of x-rays that it was in decades past. In the middle of the century, x-rays were a routine aspect of most medical examinations, and protective shielding was not provided. Doctors today are more aware of the dangers of x-rays and as overuse of x-rays decreases, so should the incidence of cancers caused by medical radiation in future decades.	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	None hypothesized.	
Extent to which threat is currently regulated	HHTWG reports the following: "NJ statutes and regulations are: Licensure requirements of operators of x-ray equipment since 1969 [Radiologic Technologist Act (N.J.S.A. 26:2D-24 et seq.)]; and regulations for X-ray equipment performance and personnel safety since 1969. (N.J.A.C. 7:28 et seq.). BRH's May 1, 2000 proposal of a medical quality assurance regulation (N.J.A.C. 7:28-22) for radiographic, fluoroscopic, and CT equipment used for medical purposes should result in a reduction of patient exposure dose." In addition, the U.S. Food and Drug Administration (FDA) regulates x-ray machines, requiring periodic inspections to insure that proper doseages are being administered.	

Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	H: Medical Offices in large hospitals fall into this category.
Small business industry	H: Smaller medical offices fall into this category.
Transportation	L
Residential	L
Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L

Issue: Medical X-Ray Radiation
Author: John Posey
Version: 09/00

References	American Cancer Society, 2000. "Incidence and Mortality Rates by State." www.cancer.org National Institute of Health, 1997. Disease-Specific Estimates of Direct and Indirect Costs of Illness and NIH Support." John W. Gofman, 1999. *Radiation from Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease: Dose-Response Studies with Physicians per 100,000 Population*. San Francisco: Committee for Nuclear Responsibility. J. Boice, M. Morin, A. Glass, G. Friedman, M. Stovall, R. Hoover, and J. Fraumeni, 1991. "Diagnostic X-ray Procedures and Risk of Leukemia, Lymphoma, and Multiple Myeloma." *Journal of the American Medical Association*, volume 265.
Current Policy and Regulatory Framework	See "Regulation," above
Federal	
State & Local	

Medical X-rays: Like other forms of radiation, x-rays are carcinogenic. Studies in the last decade indicate that medical radiation may account for 2-8% of all cancer cases nationally. A consensus exists that despite the risks, medical radiation is, on balance, beneficial to society. Still, medical radiation does pose some costs to society, and it behooves the medical community to be conservative with the use of x-rays.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact **Factors Affecting Risk Estimation**	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**
Severity	0.1	0.1	2	0.1	2
Duration/ Irreversibility	2	2	3	2	2
Scale (spatial, population)	3	3	3	3	3
Subtotal Risk	0.6	0.6	18	0.6	12

Average Risk (0 – 5 years)	**Average Risk (5 years plus)**
6.36	**6.36**

Socioeconomic Impact	**Property Values**	**Employment**	**Costs Incurred**	**Aesthetic Levels**	**Psychological Impacts**	**Average Uncertainty**
Uncertainty Level	1	1	2	1	3	1.6

Other Stressor Analyses

Issue: Medical X-Ray Radiation
Author: John Posey
Version: 09/00

Trend: +

Catastrophic Potential: L

Issue: Microorganisms in Wildlife
Author: Mary Downes-Gastrich
Version: 05/04/00

Microorganisms in Wildlife

MICROORGANISMS NOT CHARACTERIZED BY A RISK ASSESSMENT:
It was reported that there are numerous viruses, and some bacteria and fungi which are ubiquitous in wildlife populations but they are ubiquitous and not manageable. Retrieving all the data and information on isolated cases is not possible at this time (Doug Roscoe, NJDEP/DFG&W, pers. comm.). We were told that there were reports of virus in fish and mosquitoes that may affect wildlife, but there are insufficient data for characterization (Bob Soldweldel, NJDEP/DFG&W, pers. comm.). We also were informed that while there is an infinite number of microbial pathogens affecting wildlife, some of which may be exotic, retrieving information on all the reports would not contribute to an adequate characterization at this time. While many pathogens affect agricultural crops, there are few microorganisms, outside of those already characterized in this report, that may have significant negative effects on the plant ecology (Richard Buckley, Rutgers University, plant pathology, pers. comm.). A discussion of microorganisms not included in the risk assessments is included below.

VIRUSES
The presence of viruses is ubiquitous in many types of organisms. Even the brown tide alga, *Aureococcus anophagefferens,* characterized in this report, in Barnegat Bay was reported to contain intracellular viral-like particles (VLPs)(Gastrich et al. in press). Viruses or VLPs have also been reported in oysters (e.g., Velar virus disease, herpes-type virus disease, viral gametocytic hypertrophy, nocardiosis), pearl oysters (Papova-like virus), mussels, clams, and crabs but these infections appear ubiquitous and there is insufficient data to fully characterize the risk to shellfish in New Jersey at this time.

BACTERIA:
There are reports of bacterial infectious diseases caused by *Vibrio* spp and other bacteria in commercially exploited shellfish and/or crustacea (e.g., oysters, clams, scallops, abalone, lobsters, and shrimp). *Rickettsia-like organisms are also ubiquitous in shellfish (e.g. in oysters, mussels, clams, cockles, scallops, lobsters and shrimp), these microbial infections appear to be ubiquitous in geographic distribution (Fisheries and Oceans, Canada, 1999). In addition, other bacterial infections (e.g. *Baculovirus penaei*) have been reported in shrimp and crayfish (Fisheries and Oceans, Canada, 1999). At present, there are no data indicating any specific ecological problems in terms of bacterial infections with specific species at this time. It was reported that deaths of ducks and geese, due to "limberneck" disease, were caused by *Clostridium botulinum*. The toxin produced by this bacterium is consumed by animals feeding on benthic plants. The bacterium which grows in the mud of stagnant ponds in NJ and in large shallow lakes, is associated with the death of least 30 ducks recently (Keith Cooper, Rutgers University, pers. comm. and Bob Harris, Rutgers University, State Vet, pers. comm.), there is insufficient data to characterize this risk.

*Rickettsia-like organisms = bacteria (often dispersed by animal vectors) that are obligate intracellular inhabitants for reproduction (similar to viruses) and lack enzymatic mechanisms needed to produce adequate amounts of ATP (Atlas & Bartha, 1981).

PROTOZOA
There are reports of numerous types of protozoan infections reported in shellfish (Fisheries and Oceans, Canada, 1999) but MSX, Dermo and QPX are diseases which represent the greatest risk to shellfish in New Jersey at this time.

FUNGI
There are reports of *Chlamydia*-like (e.g., fungal organisms) in oysters, mussels, clams, scallops, cockles, abalone, lobsters, and shrimp but these microbial infections appear to be ubiquitous in geographic distribution (Fisheries and Oceans, Canada, 1999). Chytrid-like fungal disease of clams has also been reported in clams in Canada and in the region (Fisheries and Oceans, Canada, 1999), but there are insufficient data for characterization of these fungi. In New Jersey, it was reported an ergot-like fungus (e.g., *Aspergillus* spp.) parasite in *Spartina* floats in aquatic systems, which may be hazardous to fish and wildlife (e.g., may cause pneumonia in geese) (Bob Harris, pers. comm.). We received an article in draft from Jim White (Rutgers Univ.) that investigated the ergot fungus, *Claviceps purpurea*, in *Spartina,* but the article (Duncan et al. , 1999, submitted for publication) dealt with the systematic relations, morphology and ecological features of the ergot for taxonomic purposes and the information was not sufficient for a risk assessment at this point. It was also reported to us (Doug Rosco and Bill Stansley, NJDEP/DFG&W) that while *Aspergillus* has been reported to cause pneumonia in geese, it is not very manageable.

Issue: Microorganisms in Wildlife
Author: Mary Downes-Gastrich
Version: 05/04/00

References

Atlas, R.M. & R. Bartha. 1981. Microbial Ecology: Fundamentals And Applications. Addison-Wesley Publishing Co. Reading, MA.

Fisheries and Oceans Canada. 1999. Synopsis of Infectious Diseases and Parasites of Commercially Exploited Shellfish. E-mail: http://www.pac.dfo-mpo.ga.ca/sci/sealane/aquac/pages/toc.htm

Issue: Pesticides- Poisoning of Wildlife
Author: Gillespie/Rush
Version: 04/17/00

New Jersey Comparative Risk Project
Ecological Technical Work Group
Stressor-Specific Risk Assessment

Risk Assessment Framework	Findings
Hazard Identification	
Stressor	**Pesticides - Poisoning of Wildlife**
Description of stressor	During a 16-month period in 1996-1997, NJ Division of Fish, Game and Wildlife, Office of Fish and Wildlife Health and Forensics scientists William Stansley and Douglas E. Roscoe documented chlordane poisoning in six species of songbirds and four species of raptors in New Jersey. Noteworthy among these cases are recurring mass mortalities of birds at suburban roosts. At one roost in Scotch Plains, NJ, the scientists recovered a total of 425 dead or sick birds over a 3-week period in July 1997. Sick birds displayed signs consistent with cyclodiene poisoning, including convulsions, osithotonos, and excessive vocalization. Brain metabolite residues indicative of chlordane poisoning were found in all 23 specimens analyzed. We believe this to be the largest chlordane poisoning incident reported in the United States. (Other states may have had larger Chlordane poisoning incidents and simply not reported them.) Chlordane poisoning was also diagnosed in nine Cooper's hawks, a state-listed endangered species. The timing of the Cooper's hawk mortalities coincides closely with the July peak in songbird mortalities, suggesting that the hawks might be feeding on birds debilitated with chlordane. The results of this and other studies suggest that chlordane poisoning of birds may be more common than is currently recognized. Chlordane was introduced in the United States in 1947 and was the first cyclodiene insecticide used in agriculture. Chlordane was also used as both an insecticide and an herbicide to control lawn, garden, and commercial pests and weeds in turfgrass. In 1976-77 it was the second most important organochlorine (OC) pesticide after toxaphene.
Stressor-specific impacts considered: Biological integrity Biodiversity Habitat/ecosystem health Ecosystem function	Pesticides put a stress on biological integrity, habitat/ecosystem health, and proper ecosystem function.
Key impacts selected (critical ecological effects)	Chlordane poisoning of birds in NJ.
Exposure Assessment	
Exposure routes and pathways considered	Passerine birds are presumably exposed to chlordane through the ingestion of soil invertebrates. Specific prey species were not identified because the stomachs of the poisoned birds were empty in virtually all of the test cases. Japanese beetles, adult and larvae, are readily consumed by several species of birds. The emergence of cyclodiene-resistant scarab beetle populations in the northeastern United States in the late 1960's and early 1970's probably accounted for most of the poisonings they observed. Dieldrin resistance has been reported in Japanese beetles at a golf

	course in Bergen County. The only diagnosed case of dieldrin poisoning to date in New Jersey also occurred in Bergen County.
Population(s)/ecosystem(s) exposed statewide	At present, we do not know how widespread chlordane contamination is in New Jersey. The focus of the study used in this write-up was in Scotch Plains, NJ.
Quantification of exposure levels statewide	At one roost in Scotch Plains, NJ, the scientists recovered a total of 425 dead or sick birds over a 3-week period in July 1997. Sick birds displayed signs consistent with cyclodiene poisoning, including convulsions, osithotonos, and excessive vocalization. Brain metabolite residues indicative of chlordane poisoning were found in all 23 specimens analyzed. We believe this to be the largest chlordane poisoning incident reported in the United States. Chlordane poisoning was also diagnosed in nine Cooper's hawks, a state-listed endangered species. Recent bird poisonings due to chlordane have not been widely reported in the literature. However, the findings presented here and in previous studies suggest that such poisonings are more common than is currently recognized
Specific population(s) at increased risk	Raptors.
Quantification of exposure levels to population(s) at increased risk	Chlordane poisoning was diagnosed as the primary cause of death in all 23 birds analyzed in 1997. Heptachlor epoxide and oxychlordane residues (ug/g) in moribund birds (mean=4.6, range=2.8-8.4, n=14; mean=4.8, range=2.1-6.4, n=14, respectively) were similar (p=0.6685) to those in dead birds (mean=4.9, range=2.5-8.7, n=9; mean=4.5, range =1.6-6.3, n=9, respectively). Brain ChE activity was determined in 17 grackles, 3 robins, and 3 starlings. Cholinesterase activity was depressed in one starling (27%) and one robin (20%).
Dose/Impact-Response Assessment	
Quantitative impact-assessment employed	Birds were collected by the scientists or submitted by either a wildlife rehabilitator or private citizens from July 1996 through October 1997. Dead birds were returned to the laboratory on ice. Moribund birds either died in transit to the lab or were euthanized by decapitation or bilateral thoracic compression. The species, date of death or submission, location, clinical signs, age, sex, and weight were determined for the birds submitted for necropsy. Gross lesions were recorded. Tissue samples from the brain, liver, kidney, spleen, lung, stomach, intestine, and pancreas were fixed in 10% neutral phosphate-buffered formalin. The brain was bisected midsagitally, and after a thin (2mm) sagittal section was taken for histopathology, the remaining two samples were frozen for cholinesterase (ChE) assay and pesticide residue analysis. Fixed tissues were dehydrated, embedded in paraffin, sectioned at 5um, stained with hematoxylin and eosin, mounted on glass slides, and coverslipped. The stained sections were examined under light microscopy for pathologic lesions and organisms.
Risk Characterization	

Risk estimate(s) by population at risk		Score
Assessment of severity/irreversibility	Recent bird poisonings due to chlordane have not been widely reported in the literature. However, the findings presented here and in previous studies suggest that such poisonings are more common than is currently recognized.	1.5
Assessment of frequency of effect(s)	The timing of the mortalities in the study used for this write-up is consistent with the findings of other researchers studying this issue (Okoniewski and Novesky) who reported that 75% of all grackle poisonings occurred in July ant that most of the starling poisonings occurred in May and July. They reasoned that the timing might be related to the seasonal availability of contaminated beetle larvae and adults. In New Jersey, adult Japanese beetles begin to emerge in late June, and the population peak occurs in late July.	1
Size of population(s) and/or extent of the State/habitat affected (magnitude)	So far, evidence of pesticide poisonings of wildlife has been concentrated in a very limited number of hot spots in Bergen County and Scotch Plains.	2
	Total	{tc \l3 "Total}3

Assessment of uncertainties in this assessment (H,M,L) and brief description	Recent bird poisonings due to chlordane have not been widely reported in the literature. However, the findings presented here and in previous studies suggest that such poisonings are more common than is currently recognized. Additional research is needed on the uptake of chlordane by soil insects and raptor prey species as well as the toxic interactions between chlordane-related compounds and dieldrin to better define the risks to wildlife. (H)
Potential for additional data to result in a significant future change in this risk estimate (H,M,L) and brief description. (Data Gaps; highlight significant data needs)	There is a strong possibility that the above-cited research need, if executed, could lead to the discovery that many types of pesticides use the same exposure route. Hence, the possibilities for significant future change in the risk estimate. (H)
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, !, =,/ where + is improvement), and brief description.	In 1979 restrictions were imposed on the use of chlordane because of its potential human carcinogenicity, and after that it was used mainly for underground termite control. Chlordane is an environmentally persistent compound with an estimated half-life in soils of about 5 to 15 years. Scientists estimate that 25 to 50% of all the chlordane produced still exists unaltered in the environment. Eventually, the threat from chlordane may disappear. However, there is no assurance that the threats from a different pesticide won't replace or surpass that of chlordane (+++).

Other Stressor Analyses

Potential for catastrophic impacts (H,M,L) and brief description	Chlordane is a threat to the Cooper's hawk, a state-listed endangered species. Chlordane is also a threat to New Jersey's song birds. If we lose the hawk or any other bird, it would be a catastrophe (H).
Link to other Work Groups (e.g., socioeconomic impacts)	None.
Extent to which threat is currently managed	In 1979 restrictions were imposed on the use of chlordane because of its potential human carcinogenicity, and after that time it was used mainly for underground termite control. More than 63 million kg of chlordane were produced and used in the United States, mostly after 1960, before sales and use were suspended in 1988. Chlordane is an environmentally persistent compound with an estimated half-life in soils of about 5-15 years. It is estimated that 25 to 50% of all the chlordane produced still exists unaltered in the environment.
Barriers to restoration	It would be hard to remediate all of the Chlordane-contaminated soil in New Jersey.
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources	
NJ Primary Sources	
Large business/industry	L
Small business industry	L
Orphan contaminated sites	L
Diffuse Sources	L
Sediment sinks	L
Soil sinks	L
Non-local air sources incl. deposition	L
Biota sinks	L

Summary Statement:
During a 16-month period in 1996-1997, NJ Division of Fish, Game and Wildlife, Office of Fish and Wildlife Health and Forensics scientists William Stansley and Douglas E. Roscoe documented chlordane poisoning in six species of songbirds and four species of raptors in New Jersey. Noteworthy among these cases are recurring mass mortalities of birds at suburban roosts. At one roost in Scotch Plains, NJ, the scientists recovered a total of 425 dead or sick birds over a 3-week period in July 1997. Sick birds displayed signs consistent with cyclodiene poisoning, including convulsions, osithotonos, and excessive vocalization. Brain metabolite residues indicative of chlordane poisoning were found in

Other Stressor Analyses

all 23 specimens analyzed. We believe this to be the largest chlordane poisoning incident reported in the United States. (Other states may have had larger Chlordane poisoning incidents and simply not reported them.) Chlordane poisoning was also diagnosed in nine Cooper's hawks, a state-listed endangered species. The timing of the Cooper's hawk mortalities coincides closely with the July peak in songbird mortalities, suggesting that the hawks might be feeding on birds debilitated with chlordane. The results of this and other studies suggest that chlordane poisoning of birds may be more common than is currently recognized.

Chlordane was introduced in the United States in 1947 and was the first cyclodiene insecticide used in agriculture. Chlordane was also used as both an insecticide and an herbicide to control lawn, garden, and commercial pests and weeds in turfgrass. In 1976-77 it was the second most important organochlorine (OC) pesticide after toxaphene. Passerine birds are presumably exposed to chlordane through the ingestion of soil invertebrates. Specific prey species were not identified because the stomachs of the poisoned birds were empty in virtually all of the test cases. Japanese beetles, adult and larvae, are readily consumed by several species of birds. The emergence of cyclodiene-resistant scarab beetle populations in the northeastern United States in the late 1960's and early 1970's probably accounted for most of the poisonings they observed. At present, we do not know how widespread chlordane contamination is in New Jersey. Chlordane poisoning was diagnosed as the primary cause of death in all 23 birds analyzed in 1997. Recent bird poisonings due to chlordane have not been widely reported in the literature. However, the findings presented here and in previous studies suggest that such poisonings are more common than is currently recognized. There is a strong possibility that the above-cited research need, if executed, could lead to the discovery that many types of pesticides use the same exposure route. It is estimated that 25 to 50% of all the chlordane produced still exists unaltered in the environment. Cooper's hawks have made a recent comeback in population. Therefore, the threat from Chlordane must not be too great. Therefore the threat score is low: Total score 8; Avg score

Issue: Pesticides- Poisoning of Wildlife
Author: Gillespie/Rush
Version: 04/17/00

Statewide Analysis of Threat

Chlordane Poisoning of Wildlife {tc \l4 "*Statewide Analysis of Threat*}

Ecosystem	Severity Irreversibility	Frequency	Magnitude	Score
Inland Waters	1	1	1	1
Marine Waters	1	1	1	1
Wetlands	1	1	1	1
Forests	1	1	1	1
Grasslands	2	1	2	4
			Total Score	8
			Average Score	1.6

Risk by Watershed Management Region

THREAT = Chlordane	ECOSYSTEM				
Watershed Management Region	Inland Waters	Marine Waters	Wetlands	Forests	Grasslands
Upper Delaware	L	L	L	L	L
Passaic	L	L	L	L	L
Raritan	L	L	L	L	L
Atlantic	L	L	L	L	L

Lower Delaware	L	L	L	L	L
Region/Watershed (secondary)					
Urban	L	L	L	L	L
Suburban	L	L	L	L	L
Rural	L	L	L	L	L

H=high, M=medium, L=low; L

1

[1]All of the information and most of the language contained in this report comes directly from William Stansley and Douglas E. Roscoe's report Chlordane Poisoning of Birds in New Jersey, USA Environmental Toxicology and Chemistry, Vol. 18, No. 9, pp. 2095-2099, 1999.

Issue: Radiofrequency
Author: Debbie Wenke
Version: 10/12/00

New Jersey Comparative Risk Project
Ecological Technical Work Group
Stressor-Specific Risk Assessment

Risk Assessment Framework	Findings
Hazard Identification	
Stressor	**Radiofrequency** (RF) between the frequencies of 3 kilohertz and 100 Gigahertz.
description of stressor (including etiology)	RF radiation is radiation that does not ionize the medium through which it is passing. If the atom absorbs the energy of the wave, the electron will achieve a higher energy state. The end product may be heat or a reorientation of polar molecules in the RF field. RF radiation is generated by sources including but not limited to: broadcasting and communications antennas, radar, navigational aids, amateur radios, cell phones, microwave ovens, MRI machines, medical diathermy units, RF scalpels, RF arc welders, electronic article surveillance units, and metal detectors.
stressor-specific impacts considered including key impacts	Tissue damage – via heating that can result in damage to various exposed organs.[1,2] Disease promotion – through biochemical changes that take place while tissue is exposed to RF radiation. Body may see RF as a stressor, thus making it difficult to fight disease.[2] Developmental tissue damage – tissue damage to a developing fetus resulting in birth defects and miscarriages.[2,3,4]
Exposure Assessment	
exposure routes and pathways considered **(include indoor air as appropriate)**	Immersion of whole body or part of body in RF field.
population(s)/ecosystem(s) exposed statewide	Consumers using RF emitting devices such as cell phones, microwave ovens, walkie-talkies and amateur radios. Medical personnel and patients using RF generating medical devices. Individuals living near or passing by RF broadcasting or communications sources in the environment. Working in industries that use RF generating devices.
quantification of exposure levels statewide, including populations at significantly increased exposure **(include indoor air as separate category as appropriate)**	Estimate 95% of NJ population exposed to whole body exposures less than 0.4 watts/kilogram (W/kg) (0.4 W/kg is the basis for the regulatory limits).* 5% of population may receive exposures greater than 0.4 W/kg.*

Other Stressor Analyses

specific population(s) at increased risk	Operators of induction heaters, sealers and industrial ovens (heat sealers). Workers who routinely climb energized communications towers for various purposes or frequently access rooftops where transmitting antennas present. Fetuses of heat sealer operators or tower/roof workers. **All of the measurements made so far on broadcast towers and similar large-scale spirces, coupled with the latest epidemiological findings would indicate that there should be no adverse health impact from living near these towers. The RF exposure levels to which these populations are exposed are low.**
quantification of exposure levels to population(s) at increased risk (i.e., susceptible sub-populations) **(include indoor air as separate category as appropriate)**	Estimated 50% of exposed adult population (estimated 1,500 individuals) receive exposures greater than 0.4 W/kg.* **5% of exposed population (estimated 75 individuals) may be subject to routine exposures resulting in energy absorption of 4 W/kg.*** Estimate that 50% of all fetuses exposed may receive exposures greater than 2 W/kg.* (Exposure to fetus may be 5x higher than exposure to the mother.[5] **)** (Estimate that 2% of the population (1,500) may be pregnant at any one time (most likely heat sealer operators, pregnant women would be less likely to climb towers). This may result in 30 exposed fetuses per year.)
Dose/Impact-Response Assessment	
quantitative dose/impact-assessment employed for each population considered	Exposures less than or equal to 0.4 W/kg, should be of minimal, if any, risk. All exposed adults: 0.4 – 1 W/kg – onset of human thermoregulatory responses.[4] 1 – 4 W/kg – Some adverse human health effects may begin in this range.[4] 4 – 8 W/kg – Potential for behavioral disruption and severe heat stress.[4,6] 2 – 30 W/kg – Possibility of death, severe heat stress, excessive increase in core temperature, reduced body weight, agitation, fatigue, behavior disruption.[4] Exposed fetuses: 2 – 30 W/kg – Possibility of death, embryonic & fetal resorption[4]
Risk Characterization	
risk estimate(s) by population at risk including probability and number of cases/occurrences (specify risk metric employed, e.g., mean population risk upper percentile population risk, etc.)	Heat sealer operators – high risk to 1,500 workers, estimated 15 (1% of 1,500) cases (total, not each) of tumor promotions, infertility and tissue damage to eyes and hands per year.*

Other Stressor Analyses

	Fetuses of heat sealer operators – high risk to 30 fetuses, estimated 15 fetal resorptions, miscarriages or genetic damage per year.* (We have no way of accurately obtaining the number of people exposed or potentially exposed to levels which may exceed the threshold for health effects since we do not require incident reporting or submission of medical records of RF workers to DEP. Epidemiological studies are relatively few and results conflicting. "Epidemiological and comparative clinical studies do not provide clear evidence of detrimental health effects in humans from exposure to RF fields".[2] Data on RF accidents is scarce but effects are more concrete.)
assessment of severity, persistence, irreversibility, frequency of effect(s) (categories as appropriate)	Environmental, general population exposures – low levels, no adverse health effects anticipated. Consumer products – most devices produce moderate to low levels except in the case of cell phones, where RF levels in the brain may be high enough to cause tumor promotion, although this has not been conclusively proven [7,8,9,10] Also, the adverse health effects of partial body exposures are inconclusive at this point. Industrial exposures, adult – 50% of population may be exposed to RF levels >0.4 W/kg. Effects may be severe. For heat sealer operators, 15 cases of tumor promotion, tissue damage to eyes and hands and infertility may occur per year. Infertility may be reversible. Industrial exposures, fetal – One half of all the exposed fetuses (15 out of 30) may be subject to resorption, miscarriage or genetic damage. These effects would not be reversible.
size of population(s) affected	Consumer product exposures – 33% of total NJ population.* Medical exposures – 5%* Environmental exposures – 25% of NJ population.* Industrial exposures – 3,000*
assessment of uncertainties in this assessment (H,M,L) and brief description, and data gaps	H – estimates based on DEP personnel experience. No good numbers outside the NJDEP exist on which to base these estimates.
potential for additional data to result in a significant future change in this risk estimate (H,M,L) and brief description	H for medical exposures and some consumer devices. Not much is known about these exposures. M for industrial exposures. L for all other exposures.
potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, , =, where + is improvement)	++, research is ongoing in the biological effects of RF radiation.
potential impact from catastrophic (low probability) events (H,M,L) and brief description of likelihood	L for all sources of RF radiation.
extent to which risks are currently reduced through in-place regulations and controls	Cell phones, exposure of patients to medical RF sources, portable radars and other mobile and portable consumer products are not regulated by DEP. Exposure of operators of stationary

	medical sources, environmental and industrial RF sources are regulated. The only sources actively inspected are heat sealers. If inspected, risks are reduced from H to L.
Relative Contributions of Sources to Risk (H,M,L)	
Allocation of stressor-specific risk to primary NJ sources	
Large business/industry	H
small business industry	H
Transportation	M
Residential	L
Agriculture	N/A
Recreation	L
resource extraction	M
Government	L
natural sources	N/A
contaminated sites	N/A
diffuse and non-NJ sources	N/A
Sediment	N/A
Soil	N/A
non-local air sources (including deposition)	N/A
biota sinks	N/A

Severity of specified health effects at current levels of exposure (H,M,L) (also 1-5 with 1 being least severe)	Size of population at significant risk for each health effect (H,M,L) (also 1-5 with 1 being smallest)	Are there discrete communities at elevated risk? (Y,N) (also 1-5 with 1 being the lowest probability that there are discrete communities at elevated risk)	**Overall risk ranking (as a function of severity and population effected integrating across health effect) (H,M,L) (also 1-5 with 1 being the lowest overall risk)**
5)Fetal resorption, miscarriage and genetic damage	L -2 (15 per year*)	Y, 3*	5*H
5)Tumor promotion	L -2 (3 per year*)	Y, 4*	4*H
4) Damage to eyes	L -2 (3 per year*)	Y, 3*	3*M
4) Infertility	L -2 (3 per year*)	Y, 4*	3*M
3) Tissue damage to hands	L -2 (3 per year*)	Y, 3*	2*M
2)Severe heat stress	L -2 (3 per year*)	Y, 5*	1*L
			2- LM

*Estimates based on experience of DEP's Nonionizing Radiation Program

References

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Issue: Tentatively Identified Compounds (TICs)
Author: John Posey
Version: 02/01

NJ Comparative Risk Project
Socio-economic TWG
Stressor Risk Assessment

Socio-economic Risk Assessment Framework	**Findings/Notes**
Hazard Identification	
Stressor	**Tentatively Identified Compounds (TICs)** in drinking water.
Description of stressor	In 1995, the NJ Department of Health and Senior Services (NJDHSS) evaluated the occurrence of childhood cancer in Toms River/Dover Township, Ocean County. The evaluation was performed at the request of the federal Agency for Toxic Substances and Disease Registry (ATSDF). NJDHSS found that there is an unusually high cancer rate among children in this area. These cancer cases have become known as the Toms River Cancer Cluster. NJDHSS continues to study the cluster, and has not yet identified the causes for the epidemic. However, many town residents believe that two companies—Union Carbide and Ciba Geigy—caused the cancer cluster by polluting the drinking water with TICs. These residents are represented by famed attorney, Jan Schlichtmann, the subject of a popular movie about a court case in Massachusetts concerning TICs in drinking water.
Ecological/Human Health Risks (including their relationship to socio-economic impacts)	There is a hypothesized link between TICs and cancer.
Stressor-specific impacts considered (including direct socio-economic impacts and those caused by ecological and human health risks):	If TICs cause cancer, then they are the source of medical costs. In addition, concern over TICs is significant among residents of Toms River.
Key impacts selected (critical socio-economic effects)	Costs incurred, worry.
Exposure Assessment	
Socio-economic entities exposure routes and pathways considered	The hypothesized pathway is ingestion of drinking water on the part of children in Toms River.
Quantification of exposure levels statewide	TICs are not commonly tested for. Incidence is presumed to be localized in Toms River.
Specific socio-economic entities at increased risk	Children in Toms River.
Quantification of exposure levels to entities at	100%

Other Stressor Analyses

increased risk		
Dose/Impact-Response Assessment		
Quantitative/Qualitative impact-assessment employed	For medical costs, I rely on Cost of Illness data published by the National Institutes of Health. For information on cancer incidence, I rely on epidemiological surveys by NJDHSS. I rely on a qualitative assessment to analyze psychological impacts.	
Risk Characterization		
Risk estimate(s) by socio-economic entities at risk		*Score*
Property Values	a) Severity: It is possible that a suspected cancer cluster could affect property values in Toms River. Although this impact would be fairly small in terms of statewide impact, it could have a much higher impact in Toms River.	1
	b) Duration/irreversibility	1
	c) Scale: Highly localized.	1
	d) Uncertainty	1
Employment	a) Severity: No impact hypothesized	0.1
	b) Duration/irreversibility	1
	c) Scale	1
	d) Uncertainty	1
Costs Incurred	a) Severity: In the Toms River area, officials have identified 90 children with cancer between 1979 and 1995. On average, a town of that size would be expected to suffer about 67 cases in that time period. Thus, there were about 23 more cases than would be expected. According to NIH, an average case of cancer costs about $80,000. Thus, if TICs may be blamed for each of these 23 cases, then the total cost of illness would be about $1.8 million. NJCRP guidelines call for a score of "1" to be given to any impact with a cost less than $16 million. However, within Toms River, the costs may be considered fairly serious. It should also be noted that TICs have not been conclusively identified as the cause of these excess cancer cases. Thus, the total medical costs associated with TICs could be as low as $0. More definitive epidemiological findings should be available by the end of 2001.	1
	b) Duration/irreversibility:	1
	c) Scale: Highly localized.	1
	d) Uncertainty	1
Aesthetic Levels	a) Severity: No impact hypothesized	0.1
	b) Duration/irreversibility:	1
	c) Scale:	1
	d) Uncertainty:	1

Psychological Impacts	a) Severity: If the 60 families involved in the legal action concerning Ciba Geigy and Union Carbide are representative, then concern about TICs is probably very high in Toms River.	2
	b) Duration/irreversibility: Unknown	1
	c) Scale: Highly Localized	1
	d) Uncertainty: This assessment is fairly speculative.	3
Potential for additional data to result in a significant future change in this risk estimate (H, M, L) and brief description. (Data Gaps; highlight significant data needs)	H: Epidemiological studies may demonstrate that TICs are probably the cause of dozens of cancer cases in the Toms River area. At present, there is no conclusive evidence either for or against this hypothesis.	
Potential for future changes in the underlying risk from this stressor (+++, ++, +, 0, -, --, --- where + is improvement), and brief description	0 Unknown	
Potential for catastrophic impacts (H,M,L) and brief description	L	
Incidence of impacts (affected sub-groups, variability, equity issues)	Children appear to be especially susceptible.	
Extent to which threat is currently regulated	The chemicals involved are fairly rare, and appear to have escaped most regulatory attention. Tort action is currently the chief legal remedy for diseases caused by TICs.	
Relative Contributions of Sources to Risk (H,M,L); include any information/details on sources		
NJ Primary Sources		
Large business/industry	H	
Small business industry	L	
Transportation	L	
Residential	L	

Other Stressor Analyses

Agriculture	L
Recreation	L
Resource extraction	L
Government	L
Natural sources/processes	L
Orphan contaminated sites	L
Diffuse Sources	
Sediment sinks	L
Soil sinks	H It is possible that TICs may leach into groundwater after being deposited into soil.
Non-local air sources incl. Deposition	L
Biota sinks	L
Current Policy and Regulatory Framework	See regulation, above.
Federal	
State & Local	
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Issue: Tentatively Identified Compoutnds (TIC)
Author: John Posey
Version: 02/01

Tentatively Identified Compounds (TICs): In 1995, the NJ Department of Health and Senior Services (NJDHSS) evaluated the occurrence of childhood cancer in Toms River/Dover Township, Ocean County. NJDHSS found that there is an unusually high cancer rate among children in this area. These cancer cases have become known as the Toms River Cancer Cluster. NJDHSS continues to study the cluster, and has not yet identified the causes for the epidemic. However, many town residents believe that two companies—Union Carbide and Ciba Geigy—caused the cancer cluster by polluting the drinking water with TICs. These residents are represented by attorney, Jan Schlichtmann. Thus far, there is no conclusive evidence that TICs are at fault. More definitive epidemiological studies should be finished by the end of 2001. Even if TICs are found to be responsible for the elevated cancer rate in Toms River, the medical costs associated with these cancer cases would be less than $2 million. This is considered a low impact under NJCRP guidelines. However, the local impact may be considered to be much higher. There appears to be a moderate degree of worry about TICs in the Toms River area, although this worry is highly localized.

Socio-economic Impact Evaluation of Environmental Issue:
Scoring system: High (3), Medium (2), Low (1), and Insignificant (0.1).
Subtotal Risk = multiplicative product of the three factors; Total Risk is the sum of subtotal risks.

Socioeconomic Impact Factors Affecting Risk Estimation	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts
Severity	1	0.1	1	0.1	2
Duration/ Irreversibility	1	1	1	1	1
Scale (spatial, population)	1	1	1	1	1
Subtotal Risk	1	0.1	1	0.1	2

Average Risk (0 – 5 years)	Average Risk (5 years plus)
0.84	**0.84**

Socioeconomic Impact	Property Values	Employment	Costs Incurred	Aesthetic Levels	Psychological Impacts	Average Uncertainty
Uncertainty Level	1	1	1	1	3	1.4

Trend: 0

Catastrophic Potential: L